

MUNICIPAL SOLID WASTE MANAGEMENT IN VARIOUS CITIES: A LITERATURE REVIEW

TRUPTI PHAPAL¹, S. M. BHOSLE² & AMOL KULKARNI³

¹PG Student, Department of Technology, Shivaji University, Kolhapur, Maharashtra, India

²Co-ordinator, Shivaji University, Kolhapur, Maharashtra, India

³Professor, Shivaji University, Kolhapur, Maharashtra, India

ABSTRACT

Due to rapid increasing population, urbanization and industrialization waste generation rate also increases but, Municipal authorities are not able to collect all waste and they are not having advance technology for treating such waste it gives result in form of pollution. Improper Municipal solid waste management causes Air pollution, land pollution as well as water pollution. Due to uncontrolled dumping of waste on street side, open ground various types of diseases are spreading, it gives ugly look. Two of the major problems being faced are the insufficient collection system and improper disposal of MSW. To avoid this it is necessary to adopt proper MSWM systems. Study present a review of the available literature on SWM problem, impacts of pollutant on environment, characteristics, physical composition & disposal method adopted in various cities

KEYWORDS: Municipal Solid Waste Management (MSWM), Collection, Transportation, Characterization, Environmental Impacts, Composting & Landfilling

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INTRODUCTION

Municipal Solid Waste Management means classifying waste according to their category and processing them by applying 3R principals so volume of waste get reduced and it lower down environmental load. Municipal Solid Waste Management (MSWM) consist of various steps which are direct waste generation, storage collection, source separation, processing, transport, treatment, recovery and disposal. If proper waste management not carried then it create various problems and pollution issue. Such as causing land pollution due to open dumping of waste without treatment, causing water pollution if waste is discharged into water bodies and also cause air pollution due to burning of waste under free atmosphere. The urban population of India generated 114,576 tons/day of municipal solid waste (MSW) in 1996, which was predicted to increase by four times to about 440,460 tons/day by the year 2026. Per capita waste generation in major cities ranges from 0.20 Kg to 0.6 Kg.

Improper disposal of waste directly & indirectly affects on human body & surrounding living organisms. It gives bad appearance & produce bad smell so it becomes intolerable to survival near such sites. It was found that some disease also spread such as dysentery, cholera, plague, typhoid, infective hepatitis etc. Municipal solid waste management become a very critical and important issue in India, so it becomes necessary to think about it and to take strict action against it.

The purpose of this paper to guide the reader through the available literature on present waste management status of various cities.

LITERATURE REVIEW

Available literatures on solid waste management are divided into following parts:

- Present MSWM status in various cities.
- Physical, chemical characteristics of MSW
- Impacts of pollutant
- Use of 3 R for MSWM
- Composting technology as a processing option.

PRESENT MSWM STATUS IN VARIOUS CITIES

C R Mohmanty et al (2014): Studied the existing state of municipal solid waste management (MSWM) in Bhubaneswar city. Their aim was to identify the reasons which causes obstructions in achieving good management system in the city. They found that existing solid waste management system in the city is highly inefficient. Only primary and secondary collection of waste, transportation and open dumping was carried by the local authority of Bhubaneswar. In this paper they found the sources of obstacles in the existing solid waste management system in Bhubaneswar city. They states that due to rapid urbanization and population growth of Bhubaneswar city there will be increase in the overall waste generation in the coming years. They found that lack of human and financial resources, improper choice of SWM technology, inadequate coverage and lack of short and long term planning are responsible for the poor state of affairs. The city is facing these problems so there is a need to plan and adopt new solid waste management scheme which will improve the MSW condition of city and also helps to raise the living standards of people. They concluded that there is an urgent need to improve the situation to stop further decay and deterioration of the city.

Bunrithseng et al (2010): They studied present condition of municipal solid waste management (MSWM) in the municipality of Phnom Penh (MPP), Cambodia. They identified Problems with the current MSWM, challenges and recommendations for future improvement. MPP is a small city with a total area of approximately 374 km² and an urban population of about 1.3 million in 2008. From detail study of MSWM in MPP they concluded that there has been a rapid increase of solid waste generated in MPP from 0.136 million tons in 1995 to 0.635 million tons in 2015. Per capita household waste generation was 0.487 kg/c/day while the gross MSW generation rate was 0.74 kg/c/day. Informal recycling was very active, which reduced by approximately 9.3% the amount of waste going into the landfill. They found the composition of the waste generated in MPP which consist of biodegradable waste about 64% recyclable waste followed by plastics (15.5%), grass and wood (6.8%), and paper and cardboard (6.4%) other waste about 3%. They suggested composting option for sustainable MSWM in MPP. They observed that currently, overall technical arrangement, including storage and discharge, collection and transport, and disposal, is still in poor condition, which leads to environmental and health risks. They state that these problems should be solved by improving legislation, environmental education, solid waste management facilities, and management of the waste scavengers.

Maryam Masood et al (2014): They studied current status of solid waste management in Lahore, a metropolitan city of Pakistan. They carried out a systematic quantitative and qualitative assessment of physical components of present solid waste. By observing all steps collection of waste from sources to disposal they developed material flow diagram (MFD), which gives general idea about present waste management system with all related inputs and outputs. Their study showed that in the current system, waste collection and transportation is the main focus, however the collection efficiency is only about 68%. There is no official recycling system in the city. They estimated that currently about 27% of waste by weight is being recycled through the informal sector. In compost plant by using organic waste they produce 47,230 tons per year. They suggested that recycling should be governed by increasing public awareness and integrating the informal sector to make the current system sustainable and financially viable. They concluded that lack of planning, and of both public and political will, are key barriers to improving SWM services in the city. Future developments should include focus on the areas of composting, recycling.

Biubwa Ally et al (2014): Carried out study on current status of municipal solid waste management (MSWM) system in Zanzibar municipality. They carried out research on various aspects of MSWM such as waste generation, its collection and disposal, recycling. They identified the main problems which becomes obstacles in improvement of municipal solid waste management system. After all study they found that collection efficiency of Zanzibar municipality is very low which nearly about 50%. Municipality collect waste in mixed condition and they dumped without any treatment. This affect on environment and increases environmental pollution and human health risks. They found main reasons which are the municipal authority having limited budget, inadequate technical capacity, the absence of policy, lack of comprehensive legal and regulatory framework, weak enforcement of by -laws, inadequate data on generation rate and waste characteristics, poor urban planning and infrastructures.

VipinUpadhyay et al (2012): Carried out detailed study to find out the problems of solid waste management at MNIT, Jaipur. They carried detailed investigation to collect information regarding sources, quantity generated, collection, transportation, storage, treatment and disposal of solid waste in MNIT Campus. The data was collected through questionnaire, individual field visit, and interacting with people. Photographs of generation, storage, collection, transportation, treatment and disposal of Solid Waste also taken. They concluded that the present system of SWM in MNIT is not satisfactory and there is need to improve current SWM system. They suggested that the solid waste has to be disposed of scientifically through sanitary landfill and recyclable portion of the waste should be salvaged. Segregation of recyclable material would also leads to reduction in quantity of solid waste for final disposal.

OdileSchwarz-herionet al (2008): Presented paper on municipal solid waste management in the city of Karlsruhe in Germany. Untreated solid wastes frequently contain components that have the potential to cause infectious diseases. The waste management situation in Germany is constrained in various ways that differ from region to region. Once cannot, speak of an emergency. Management of domestic and bulky waste is largely assured. More serious problems arise in the management of commercial wastes; these will persist for some time. To ease the situation, greater efforts need to be made to segregate wastes at source, to sort them, and in particular, to complete, expand and newly establish treatment and recovery facilities. Until such facilities are completed, wastes will need to be sought abroad. One thing, however, is certain: There is no turning back. Acting in unison, those responsible in the federal and local authorities, in the municipal and private-sector waste management industry and in the industry federations will be able to master the difficult waste management situation in Germany.

Gajendra Mohan DevSarma et al (2015): Examined the status of MSWM in Nagaon which is class I town in Assam. For collecting primary and secondary data they designed separate questionnaires for households, ragpickers, commercial establishments, hospitals, and Municipal Board. They found that the MSWM system is not carried out proper manner from collection to disposal. They found some reasons which are responsible for inadequate SWM system in which main reason is lower collection efficiency and the absence of community participation. They observed that collection and transportation activities was improperly carried out and door to door collection and segregation were not a practice. They stated that local bodies also did not have any waste treatment/disposal practice such as recycling, composting, sanitary landfill or incineration etc. local authority gives reason that they did not possess any land for their own for waste disposal plant. They suggested to use colour coded bins for segregation at source. They suggested composting vermicomposting technology for treating organic waste.

Niyaz Ahmad Khan et al (2014): Studied How Municipal Solid Waste Management Carried Out In The City Of Srinagar In Jammu And Kashmir In India. During Their Study They Found That Msw Generation In Srinagar Has Increased Tremendously From 180 Tons In 1981 To 530 Tons In 2011. From Investigation They Found That Per Capita Waste Generation Rate Vary From 100gm To 500gm. they found factors which mainly affect on efficiency that are Wrong vehicle selection, shortage of collection vehicles, inadequate transfer points and traffic congestion, They visited municipal council and got information that collection system adopted in Srinagar is door to door collection and from street bin, but due to uncontrolled management collection efficiency lies between 65-70%. Collected waste transported for dumping to open landfill site which is at Syedpora Achan which is 6 km from center of Srinagar city and the remaining 30-35% of waste is dumped illegally into depressions, river embankments, unattended open spaces. Sometimes unattended waste burnt both by individuals or Safia Karamchari due to which pollution increase as well as it becomes centers of some diseases.

Based on the field studies on various aspects of the Transport and Disposal of Solid Waste in Srinagar, researchers concluded and recommended that MSW shall be collected, stored, segregated, transported and disposed separately without mixing with bio-medical, slaughter and construction/demolition waste and bins or containers should be cleaned before they start overflowing. Researchers suggested Land filling for non-biodegradable, inert waste and Mechanical composting plant for biodegradable waste.

PHYSICAL, CHEMICAL CHARACTERISTICS OF MSW

Patrick Akata Nwote (2015): Carried out study on municipal solid waste management and disposal methods in Abakaliki Metropolis, Ebonyi State. In their study they investigated characteristics and composition of waste and environmental issues. To obtain primary data related to environmental and issues structured questionnaires were used. Some information related to issues which are arising from the unsustainable management of the wastes were collected from oral interviews and field observations in the study areas. Their observations concluded that waste on major Street and waste from some open sites are left unattended for longer period which reduces access for road users and causing nuisance which causes air pollution and bad appearance. Due to improper collection system mixed waste is collected which is heterogeneous because it contains both biodegradable and non-biodegradable materials such as e-wastes, plastic, polythene materials, hospital wastes, garden waste and others. The study strongly recommend that Ebonyi State Environmental Protection Agency (EBSEPA) be made to sit up on their functions while Government should strongly consider introducing “waste to energy” as a way of curbing the menace of waste management and simultaneously solving the energy needs of

the State.

Swapna Das, (Feb 2013): Carried out study on municipal solid waste (MSW) management in Kolkata, India. In order to characterize the waste they carried out a long-term study between the winter of 2010 and the winter of 2011. In this study they determined and evaluate, percentage of components and specific weight of the MSW, the composting parameters (moisture content, total organic carbon, total nitrogen and pH), organic matter content, calorific value and heavy metal concentrations. The current uncontrolled disposal activity was evaluated, and the composition and characteristics of the MSW were determined. After detail study they concluded that the present disposal method, open dumping, must be immediately abandoned. The present sorting process is not effective. Ideally, all of the valuable materials should be collected separately at the source and transported to the recycling/recovery center in order to increase the economic benefit. To achieve a target of 100% collection, transportation and disposal researcher suggested to prepare a macro plan which would identify the quantity of waste generated in the municipality and the broad strategy to be adopted to manage the system.

Rajendra Kumar Kaushal (2012): Carried out Estimation of the quantity and characteristics of municipal solid waste and its forecasting over the planning period. They analyzed how trend is changed in the MSW quantities and characteristics in major urban cities in India over last four decades. They stated that there is need to select the appropriate waste management technologies with respect to the changing pattern of the waste generation, which can help the urban local bodies responsible for MSW management in preparing more efficient plans. In this paper, an attempt has been made to study the changing trends of quantity and characteristics of MSW to find its impact on the performance and capacity planning of recovery/recycle, compost, incineration and landfill facilities. The changing pattern of waste composition emphasises the importance of segregation for successful operation of waste management facilities. Municipal authorities should maintain the storage facilities in such a manner that they do not create unhygienic and unsanitary conditions. A new survey should be carried out on the generation and characterization of MSW in India.

Md.Lokman Hossain et al (2013): Conducted study at Jamalkhan Ward, Chittagong, Bangladesh to determine the waste generation rate, physical composition and characterization of solid waste (ISW) and identification of current situation of institutional solid waste management (ISWM). To get primary data structured questionnaire was processed to analyses waste characteristics waste collected from different waste generating sources. Collected waste were segregated and weighed. They found waste generation rate 0.1412kg/person/day and an average institution generated 10.42 kg of waste per day. The institutional waste generation rate by each institutional category in the study area was maximum (32%) by the educational institution followed by 21.5% by government institution and minimum (14.5%) in private institution. It also reveals that almost 604.43 kg of solid waste was generated per day in the study area. From segregation they found that institutional solid waste was comprised of nine categories of wastes with paper waste being the largest component (27%) followed by 25% of vegetables/food waste and broken glass/ceramic was minimum (1%). Hazardous medical waste was found 5%.

Neha Gupta et al (2014): Stated that due to improper management of municipal solid waste it becomes major environmental issue in india. They stated that various factors responsible for this issue that are rapid increase in urbanization, industrialization and population, the generation rate of municipal solid waste in Indian cities and towns is also increased. Mismanagement of municipal solid waste can cause adverse environmental impacts, causes various diseases and other socio-economic problem. In his paper researchers presented an overview of current status of solid waste

management in India which can help the competent authorities which are responsible for municipal solid waste Management and researchers to prepare more efficient plans. They studied Solid waste generation rate in different cities in India in which they describe city wise population, area, waste generation rate, composition of waste. They gave physical and chemical characteristics of municipal solid waste in Indian cities. Values are plotted by using different charts and tables. They briefly studied various treatment and disposal methods mostly adopted for Municipal Solid waste management in Indian cities

Hai, F. Ibney, (2005): Carried out detailed study on generation rate and characteristics of solid waste generated by Dhaka city, along with this study he analyzed environmental impacts and present solid waste management system adopted by Dhaka municipality. Main focus was given on the factors which affect on disposal due to composting and effect on transportation cost due to landfill site. For deciding location of landfill site he carried out comparative study on area required at present condition with composting and area required in future without composting, transportation cost and greenhouse effect. From his study he analyzed that by considering 40-50% of collection efficiency area required for composting ranges from 167.11 acres/yr. to 96.97 acres/yr., while that without composting it requires 206.31 acres/yr. but if composting used generation rate of methane gas would reduce by half of gas which generated without composting. From his analysis he concluded that if dumping site is selected away from city due to unavailability of land and/or higher land price it will increase three times transportation cost than that of present.

USE OF 3 R FOR MSWM

KennethPeprah et al (2015): Statedthat waste can be converted into wealth by using '3R' principals i.e reduce, reuse, recycle, but it becomes possible only when each person consider it as his responsibility. They suggested that when people store waste separately at house level, when municipal worker collect waste separately and transported to the plant then only itcan be recycled by using proper technique. Researcher assesses implementation of solid waste management in the Ghana municipality and it becomes ideal Municipality for other cities municipality which existing near Ghana. Implementation in solid waste management was started since from 2006. In which they made some rules in which each household has store waste and handle individually. Scrap metal, plastic, paper, glass and other material recycled. Volume of waste reduced by using baling machine and they sent for recycle and reuse. Ghana municipality earn revenue from waste and become good example for other ones. Resercher concluded that '3R' model is a useful strategy for proper management of solid waste because it helps to achieve sustainable environment.

COMPOSTING TECHNOLOGY AS A PROCESSING OPTION.

Late A.M, (2013): Carried out study on characeterists of Municipal solid waste in Aurangabad city Maharashtra. He carried out experimental study on aerobic composting technique by using metallic container with pore holes for studied waste generated from Aurangabad city. He carried out experiments for a period of one year with monitoring of selected parameters. The results shows that for conversion of waste into better quality compost only 40-45 days requires. Whereas the NPK value of prepared compost resemble with international standards.

Nilanthi J.G.J. Bandara (2010): Studied solid waste scenario in the Sri Lanka and he gives that composting is a good technical option for solid waste management for the country. For his analysis & work he refer past published research paper. From his study he observed that Municipal waste content maximum percentage of bio-degradable organic material which can be converted into valuable compost by setting compost plants. For selecting proper technical method he

conducted detailed waste profile case studies in two different areas from which he observed that maximum organic waste generated & collected from house hold areas which contains large percentage of organic material which can easily degrade. At present condition there are number of medium scale compost plants operating in the country. He tested few samples of compost from compost plant in which he observed that compost generated from mixed municipal solid waste has some percentage of heavy metals which can be hazardous for plants if compost used for agricultural purpose of the content. He observed that percentage of metal is still within the standard limits but nutrient levels are below the required levels. To solve this problem he suggested that if organic waste from household is collected separately without mixing with other waste and treated separately then good quality compost can be produced which contain minimum percentage of heavy metal and greater percentage of nutrients.

SUMMARY OF LITERATURE

After thorough evaluation of the related literature, it can be revealed that Municipal Solid Waste Management in different cities are highly insufficient. Researcher found that municipal authorities are not capable to achieve new advance technologies. Most of money invested for solid waste collection and transportation only. In some cities it found that under drainage systems get polluted due to infiltration of leachate. People are facing problems due to open dumping it cause air pollution, it give bad look as well as it causes various diseases which are affecting on human and environmental condition. From physical and chemical testing it was found that more that 50% of waste is biodegradable which unnecessary get mixed into other wast

CONCLUSIONS

Above mentioned literature concluded that to protect human health & environment in good condition it is necessary to adopt proper MSWM system. Main aim of system should be to minimize cost of collection and transportation and to increase collection efficiency. There are various technologies available to treat organic as well as inorganic waste i.e for organic waste can be treated by composting, biomethenation and inorganic can be disposed by landfilling. By using 3R principal maximum waste can be recovered. So, after studying all papers it concluded that MSWM is becoming a important issue & a big challenge in front of municipal authority to achieve proper MSWM system in their areas.

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